



White Paper: Hardware-In-The-Loop Verification, Validation, and Accreditation

Charles E. Hays (Logicon, Inc.)

chays@logicon.com

(540) 663-9643



OUTLINE



- PURPOSE
- INTRODUCTION
- VV&A RATIONALE
- PEO TSC VV&A PROCESS
- VV&A MODIFICATIONS
- EXISTING APPLICATIONS
- SUMMARY



PURPOSE

- Facilitate The Discussion On HWIL Accreditation Within PEO TSC
- Demonstrate HWIL Systems Must Be Accredited For Official Use In Developmental And Operational Testing
- Propose Tailoring Of The PEO TSC M&S VV&A Process To Accommodate HWIL Systems



INTRODUCTION



M&S TERMINOLOGY



DoD Definitions (DoD 5000.61 and DoD Glossary of M&S Terms)

- Model . A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.
- Simulation - A method for implementing a model over time. Also, a technique for testing, analysis, or training in which real-world systems are used, or where real-world and conceptual systems are reproduced by a model.
- Stimulator - A hardware device that injects or radiates signals into the sensor system(s) of operational equipment to imitate the effects of platforms, munitions, and environment that are not physically present.

Non-Standard Definition

- Non-Tactical Hardware - The purely physical components of a HWIL system (i.e, antenna, cables) that are not operationally deployed.



CSEDS

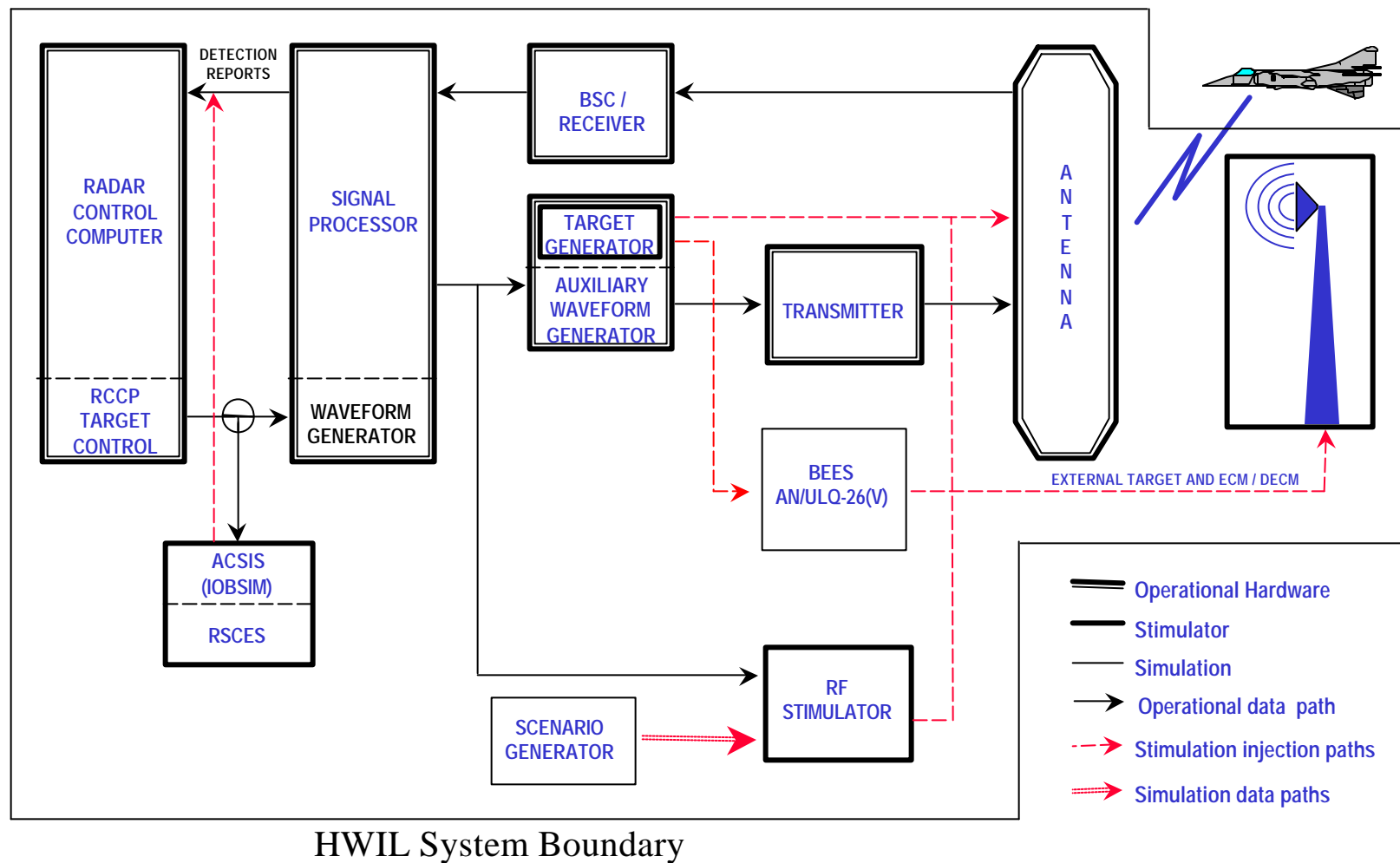
Combat Systems Engineering Development Site



This Is A Facility, Not A Simulation!



CSEDS HWIL SYSTEM EXAMPLE





VV&A Rationale

DoN INSTRUCTIONS



- SECNAV 5200.40, 19 April 1999
 - Section 3: Applicability and Scope.
 - “c. Legacy M&S which are enhanced or modified, and the enhancement, or the M&S as a result of the enhancement, meets one or more of criteria 1 through 4..”
 - “a.(1) M&S for which at least five work-years of effort has been, or will be, invested for development, modification, or enhancement.”
- COMOPTEVFOR 5000.1, 5 September 1995
 - Section 4: Scope.
 - “It includes pure mathematical simulations and computer/hardware-in-the-loop hybrid simulations.”
- PEO TSC 5200.3, 4 February, 2000
 - Section 2: Applicability and Scope
 - “a. Applicable to all PEO divisions.
 - b. All M&S (including hardware-in-the-loop (HWIL/HIL)) sponsored, managed, or used to represent PEO systems and system elements after the effective date of this instruction.”



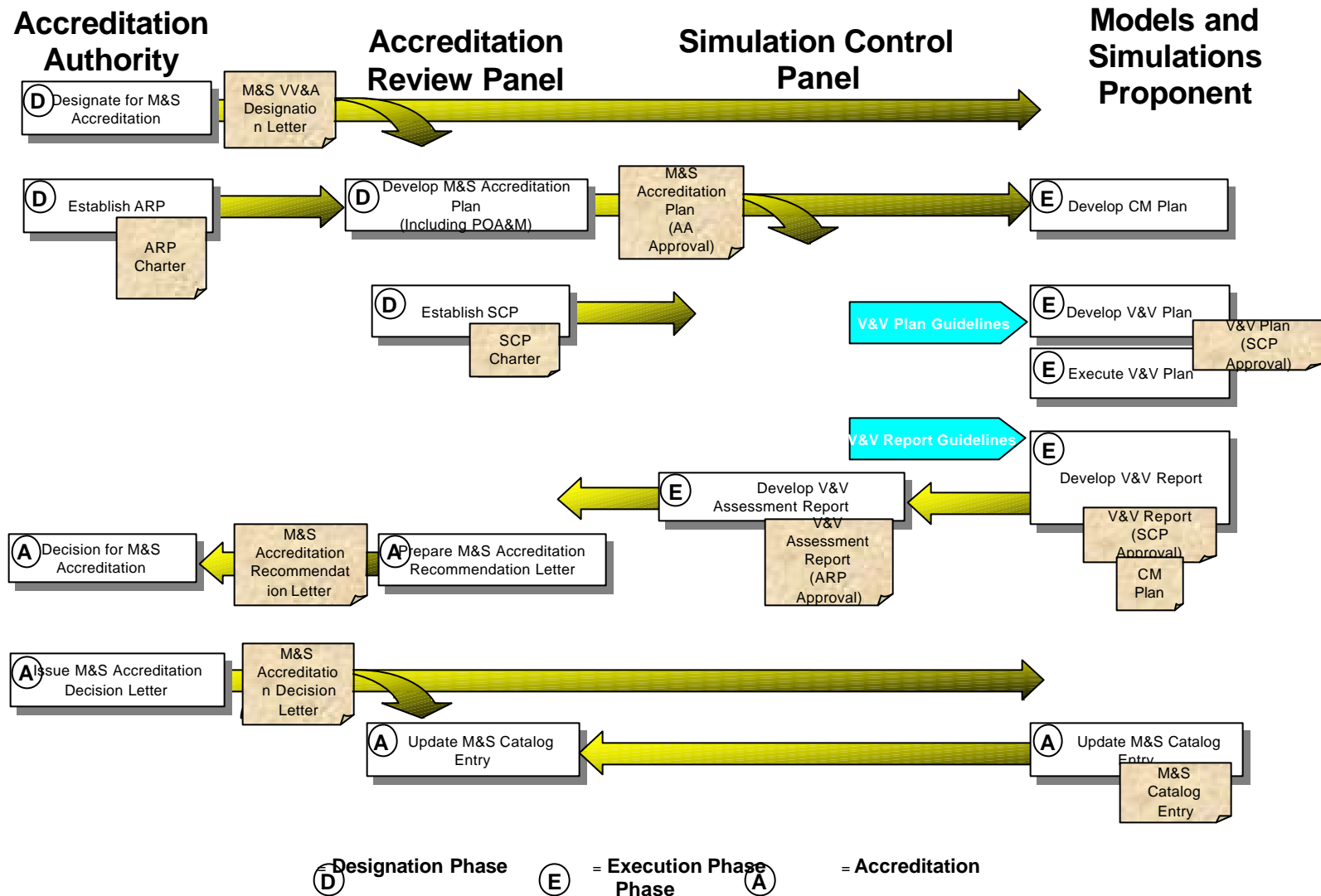
VV&A Rationale

DoD DEFINITIONS

- Modeling and Simulation - “The development and use of live, virtual, and constructive models **including simulators, stimulators**, emulators, and prototypes ...” (DoDI 5000.61)
- Simulation - “A method for implementing a model over time. Also, **a technique for testing**, analysis, or training **in which real-world systems are used**, or where real-world and conceptual systems are reproduced by a model.” (DoDI 5000.61)
- Stimulator - “a. **A hardware device that injects or radiates signals into the sensor system(s) of operational equipment to imitate the effects of platforms, munitions, and environment that are not physically present; ...**” (DoD Glossary of M&S Terms)



PEO TSC M&S VV&A Process





VV&A TAILORINGS



1. Have a separate HWIL System Accreditation Plan.

- Although the individual components of the HWIL System may require separate accreditation, the entire HWIL System should have a separate accreditation plan containing the M&S requirements, HWIL system description, acceptance criteria, V&V expectations, and integrated POA&M.
- The Accreditation Plan description of the HWIL system should include at least the following:
 - Description of major functionalities of the HWIL system
 - Diagram of the fielded operational system
 - Diagram of the HWIL system differentiating among M&S, non-operational hardware, and operational components
 - Description of each component's role in the HWIL system
 - Component listing with brief description of the components functionality, and interfaces between non-operational and operational components



VV&A TAILORINGS

(cont...)



2. Require Individual V&V Of M&S Components.

- View the HWIL System as a federation of individual components, or a system-of-systems.
- Each M&S component must undergo V&V for the functionality it contributes to the overall HWIL system, so that its capabilities and limitations are properly characterized in the HWIL system V&V Report.



VV&A TAILORINGS

(cont...)



3. Require Configuration Management of HWIL System In Addition To Individual Component Configuration Management.
 - The HWIL System CM Plan defines the process to ensure the correct versions and configuration of the components are provided for the application usage.
 - This would include, at a minimum, a documented Version Description and Change Control process.
 - Configuration Management is critical to VV&A.



VV&A TAILORINGS

(cont...)



4. Require A Single Simulation Control Panel To Oversee All V&V Execution.
 - A single SCP should manage the total HWIL System V&V process. Combining multiple HWIL Systems under a single SCP should be an acceptable modification to this recommendation.
 - The SCP would be responsible for providing a single V&V Assessment Report to the ARP for the total HWIL system.
 - This will minimize the V&V management responsibilities for the ARP, yet still ensure an integrated report.



VV&A TAILORINGS

(cont...)



5. HWIL System Accreditation Status Should Be Incorporated Into The Test Readiness Review Process.
 - Testers that utilize M&S for testing events should assess the need for accreditation and incorporate appropriate processes in their Test documents and Readiness Review.
 - This will document the Test Director's M&S accreditation decision and rationale to support the usage of test results generated by M&S.
 - In the case of operational testing, the Commander Operational Test and Evaluation Force (COMOPTEVFOR) M&S VV&A instruction requires COMOPTEVFOR accreditation 90 days prior to testing.



EXISTING APPLICATIONS



- E2-C Operational Assessment October 1999
 - Involved Multi-Functional Land-Based Test Site (MFLBTS) at Dam Neck and the Surface Combat Systems Center (SCSC) at Wallops Island
 - COMOPTEVFOR requested accreditation information on the sites after completion of testing, and refused to use data generated from the HWIL Systems with V&V data to support COMOPTEVFOR accreditation
 - Assisted in the V&V Report format for MFLBTS for PMS-465
 - COMOPTEVFOR accredited both sites based upon the provided V&V data
- CEC 2.0 OT-IIA4 And OPEVAL
 - Involves MFLBTS, SCSC, Eastville Tower Relay, and NP-3D Flying Aircraft Laboratory
 - Single Accreditation Plan and SCP for all HWIL Systems
 - Expect OT-IIA4 COMOPTEVFOR accreditation June 2000 with follow-on PMS-465 accreditation November 2000



SUMMARY



- HWIL Systems Are Increasingly Used To Support Developmental and Operational Testing
- HWIL Systems Are M&S, And Must Be Accredited For Official Use
- The Existing PEO TSC M&S VV&A Process Can Be Tailored, Primarily In The V&V Portion, To Provide A Solid Basis For HWIL System Accreditation
- The Existing Test Asset Readiness Process Should Include An Assessment Of M&S Usage For Accreditation